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ABSTRACT

A general systems approach to education is proposed. A general system is thought of not so much as a body of doctrine, but as a way of looking at things which permits the perception of the world as a totality and fosters communication among the specialized disciplines. In social science education the comparative study of relatively stable cultures is necessary. Once the idea has been established that there are stabilities in social systems, then we can go on to dynamics and developmental systems, and into concepts of economic and political development and idiological change. All real systems are dynamic, having four types of patterns in a space-time continuum: perceptible stable relationships, life cycle, evolution and learning, and the decision-making system. In this context, people should know: a little about the order of magnitude of the factual world; where to find information and how to use it; facts about the shape of the space-time continuum --the history and geography of the world; the nature and necessity of investigation; and a distrust of purely personal experience, or an awareness of cultural bias and generalization. All of these things are necessary to avoid what Veblen called "trained incapacity", an inability to live in the world as it really exists. (SBE)

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WHAT CAN WE KNOW AND TEACH ABOUT SOCIAL SYSTEMS?

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Kenneth Boulding is Professor of Economics at the University of Colorado and President of the American Economic Association. This article is adapted from a paper he presented at a conference of the Social Science Education Consortium on "Social Science in the Schools: A Search for Rationale" at Purdue University in February 1967. It will appear in a forthcoming book of the same title, edited by Irving Morrissett and W. W. Stevens, Jr. and published by Holt, Rinehart, and Winston.

My thesis is that the principle task of education in this day is to convey from one generation to the next a rich image of what I call the "total earth." The universe we can leave for the next generation but for this generation the prime task is to convey the idea of the earth as a total system. This is an idea around which one can organize a whole educational process, not only in the social sciences but all the other sciences and the arts and the humanities as well.

We start with the concept of the earth as a series of approximately concentric spheres, such as the lithosphere, the hydrosphere, the atmosphere and the biosphere. Finally we have what I have been calling the sociosphere, or the anthroposphere, which is the sphere of man and all his activities. In our day the sociosphere is becoming increasingly dominant over the others. Thanks to it the evolution of the elements is now continuing where it seems to have left off four or six billion years ago. The sociosphere is beginning to affect the biosphere very rapidly and it will be surprising if in the next generation man does not get his busy little fingers into the business of genetic evolution. We might even recreate the dodo and the dinosaur and then go on to the imaginary animals, the centaurs and the fauns. This is the kind of world for which we might have to prepare our children.

Toward A Unified Social Science

If we look closely at the various social sciences it becomes clear that they are all studying the same thing and are all operating at the same systems level. This is not true of all the sciences; thus the crystallographer studies the world at a different systems level from that of the physiologist and the physiologist from that of the social scientist. But the economist, the political scientist, the anthropologist, the sociologist, and the social psychologist, even the historian and the human geographer, are all really studying the same thing, which is the sociosphere, that is, the three billion human beings, all their inputs, outputs, interactions, organizations, communications, and transactions.

The different social scientists of course study the sociosphere from different points of view. We also carve up the set of organizations and institutions; thus economists study banks, anthropologists tribes, political scientists governments, sociologists families, and so on. In this matter we should do some trading around. It would be fun to have anthropologists study banking on the ground that bankers are really a savage tribe. The economist has already been moving in on the family, which we call a spending unit. Political scientists have already begun to look at the political structure of the corporation and the game theorists have even begun to move in on moral philosophy. All this is much to the good, but it has not yet affected our teaching very much and the way we divide up the field can easily result in a great deal of misapprehension at the level of the students who do not see that all institutions are part of the totality.

Thus I agree with Dr. Alfred Kuhn[1] that we are moving very rapidly toward a unified social science, simply because we are all coming to realize that the sociosphere itself is a unity, and offers a single system to be studied. This does not deny the usefulness of such abstractions as economic systems, the international system, or what I have recently been calling the integrative system which is that aspect of the sociosphere which deals with such matters as status, community, identity, legitimacy, loyalty, and love. We must somehow manage to teach the students that all these systems have a certain structure and dynamic of their own, that they also all interact very strongly with each other, and that they are all indeed abstractions from a total system of reality.

What I am arguing for is, frankly, a general systems approach to education. I have some prejudice here, being one of the founding fathers of the Society for General Systems Research. I think of general systems not so much as a body of doctrine as a way of looking at things which permits the perception of the world as a totality and fosters communication among the specialized disciplines.

A system can be defined as anything which is not chaos, and by this definition earth is clearly a system in spite of large random elements. The task of learning is to perceive what is chaos and what is not chaos in the world around us. It is important both to perceive order where it exists and not to perceive it where it does not, for that leads us into superstition.

The Dynamics of Systems

All real systems are dynamic; that is, they exist in four dimensions, three of space and one of time. What we are trying to do in the learning process is to try to perceive the continuing patterns in this four-dimensional solid. This is really what education is all about. This does not preclude the use of equilibrium systems which are special cases where a pattern in space-time repeats or produces it-

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self. We cannot of course visualize four dimensions directly. It is very useful, however, to visualize two dimensions of space and one of time. Thus we can visualize the earth going around the sun as a kind of spiral tapeworm, the cross-section of which in the plane of space is roughly circular.

There are four easily distinguishable types of pattern in the space-time continuum which correspond to four types of dynamics. The simplest kind is simple dynamics such as Newtonian celestial mechanics, which really involves the perception of stable relationships between today and tomorrow or between today, tomorrow, and the next day. These relationships can be described by difference or differential equations. If regularity of this kind persists we can easily project it into the future as we perceive it in the past. Thus if we have a stable relationship between today and tomorrow, we have a difference equation of the first degree. Then if we know the state of the system today we know it tomorrow; if we know it tomorrow we know it the day after and so on indefinitely into the future. Examples of such projections would be growth at constant rates, such as compound interest, population projections, and so on. In social systems we have to be careful about such projections because the differential equations are usually not stable as they are in the solar system. The astronomer is fortunate in that the planets are moved by angels which are extremely well behaved, whereas in social systems things are moved by people who are not well behaved, and if our projections are mistaken for predictions we can be led badly astray.

A famous example of projections that were falsified were the projections of the U.S. Bureau of the Census in the middle 1940's according to which the United States would have a stable population of about 180 million by the 1980's. Between 1945 and 1947 indeed we had a "system break," in which the basic parameters of the demographic system shifted in such a manner as to give us a much larger rate of population expansion than had been expected. I would very much like to see a study of the impact on the educational system of this country of planning based on these quite false projections. Almost everybody in the 1950's found themselves with much larger numbers of children to educate than they expected. Thus, when constants are not constant, as they frequently are not in social systems, we have to learn to take predictions based on constant parameters with a great deal of reserve.

The Life Cycle Pattern

A second dynamic pattern is what I have called the "wallpaper principle." If we see a wallpaper with a regular pattern we have a good deal of confidence that the pattern continues under the mirror and behind the furniture or even beyond our field of vision. Similarly, we can see the space-time continuum as a four-dimensional wall paper in which our field of vision is cut off abruptly at the present. If, however, we perceive the beginnings of past patterns we may reasonably expect them to be projected into the future. Perhaps the best example of this principle is the life cycle. Up to now, at any rate, man has shared with all other living creatures a very regular life pattern. A person's age is probably the most important single piece of information about him. We know that if he is one year old he will look like a baby and if he is ninety he will look like an old man. This pattern may, of course, be upset by the growth of biological knowledge in the next generation or so and we may be in a great danger of immortality. This would present the human race with probably the greatest crisis it has ever had to face. Who, for instance, would want to be an assistant professor for five hundred years? What makes life tolerable, especially for the young, is death, and if we do away with this we are in real trouble. It is just as well that at the moment this is something we do not have to worry about.

Life cycle patterns are found in human artifacts, such as automobiles, buildings, and so on. The concept is less applicable to social organizations which often have the capacity for self-renewal. Neither organizations nor civilizations are under the necessity of aging, although this does sometimes happen. The fact that people die, however, means that organizations can renew their youth as the old occupants of powerful positions die off and younger occupants take their place. We do not seem to be able to do this with neurons.

Mutation and Selection

A third type of dynamic system is that of evolution and learning. These can be put together because they are essentially the same thing. Even biological evolution is a learning process by which matter is "taught" to form itself into more and more improbable structures as time goes on. Similarly, human learning involves the construction of more and more improbable images in the mind. Both these processes take place by mutation and selection.

One of the difficulties with evolutionary theory is that it is hard to put content into it. It is a beautiful vision but it has extraordinarily little predictive power. There is a good reason for this, for any dynamic system which has information or knowledge in it as a fundamental element is inherently unpredictable. It has to have what I call fundamental surprise. Thus, if we could predict what we are going to know in twenty-five years we would know it now, and if we could predict the result of a research project there would be no need to do it and you could not get any money for it.

The Decision System

The fourth dynamic process is of peculiar importance in social systems, and might be called the decision system. We can see the movement of the social system through time as a kind of "decision tree" in which we keep coming to decision points at which there are a number of possible futures and select only one of these. Our decisions, however, depend on values and in man values are almost wholly learned. Instincts are quite literally for the birds. A decision tree therefore is a curiously unstable dynamic structure which is hard to predict. Decision theory states that everybody does what he thinks best at the time, which is hard to deny. The tricky problem is how do we learn not only what are the real alternatives, but also what values we place on them. It is true that we move toward the higher payoffs, but the trick is that we learn what the payoffs are only by moving toward them. The economist tends to assume that decision-making is a maximization process, something like getting to the top of a mountain. On the other hand, if we had to deduce the mountain from the behavior of people who climb it, which is the theory of revealed preference, the theory becomes dangerously close to the proposition that people do what they do, and it does not require much theory to tell us this, no matter how elegant the mathematical language in which it is wrapped. The situation is even worse than this because in actual decisions we are not climbing

a real mountain, but an imaginary mountain, and a mountain furthermore which is like a featherbed and falls in as we get to the top of it. We learn to like what we get as well as to get what we like.

One way out of this morass is to look for structures which determine decisions because perhaps they determine the information flows and corrupt or purify information as it flows up through an organization. When hearing Lawrence Senesh's delightful poem about cities I could not help adding a verse to it as I felt that the last verse was a little too Pollyannish to be realistic.[2] Here is my version of the last verse:

> The reason why cities are ugly and sad
> Is not that the people who live there are bad;
> It's that most of the people who really decide
> What goes on in the city live somewhere outside.

This simple structural fact throws a great deal of light on the whole dynamics of urban decay. At this level we have to admit that we do not know very much, although there do seem to be possibilities of knowing a great deal more in the future.

Ecological Equilibrium

How, then, does all this apply to teaching about the social system? I have been rather cool about equilibrium systems simply because a realistic appraisal must regard them as special cases of the general dynamic process. Nevertheless, as an economist I cannot throw them away because in many cases this is all we have and they are in any case a useful intellectual stepping-stone to an appreciation of a more complex dynamics. Somewhere in the teaching business, therefore, we have to tell people about equilibrium systems and we can even point to actual phenomena in society and also in the biosphere, perhaps even in the atmosphere where something like a quasi-equilibrium exists. Thus the notion of ecological equilibrium is a tremendously important concept which we must get over to the student at some point. Here I endorse Alfred Kuhn's theory that ecology is the beginning of wisdom in a great many spheres.

Somewhere in the schools we must get the idea across that society is a great pond, and just as in a pond fish, frogs, vegetation, and chemicals all interact to form a reasonably stable equilibrium of populations, so in society we have rough equilibrium at any one moment of interacting populations of criminals, police, automobiles, schools, churches, supermarkets, nations, armies, corporations, laws, universities, and ideas. The ideal time for formalizing this concept would seem to be in high school algebra when the student is studying simultaneous equations. The essential proposition of ecological equilibrium is that if everything depends on everything else and if there is one equation of equilibrium for each population, we have n-equations and n-unknowns which with a bit of luck may have a solution in which the equilibrium size of each population is consistent with the size of all the others. The fact that ecological systems do exist in nature means that sometimes these equations can be solved. Boulding's first law is that anything which exists is possible. It is surprising how many people do not believe it. There must be some ecological equations therefore which have a solution and this is worked out in the pond and the prairie and the forest and likewise in the city, the nation and the world. Even in the primary grades we could get something of this idea across.

Homeostasis and Ecological Succession

It is a big step from the concept of ecological equilibrium to the concepts of homeostasis and cybernetics by which equilibrium conditions are maintained through a dynamic process. It should not be difficult for children even in grade school to understand the thermostat and go on to see that the body regulates many processes in a similar way. Social organizations are similarly full of homeostatic mechanisms by which disruptive change is resisted and role occupants are replaced.

Recently in Poland I saw an example of the homeostasis of beauty. Many ancient buildings in Poland which were destroyed during the war have been rebuilt exactly as they were before; large parts of Warsaw have been rebuilt stone by stone, street by street, house by house, church by church, and palace by palace. The Russians did the same thing with Leningrad. Here the image of a city perpetuates itself in society because decisions are made on the basis of an idea of beauty from the past. The astonishing recovery of nations such as Japan and Germany after a destructive war is a good example of how an old equilibrium reasserts itself.

The next concept beyond that of ecological equilibrium and homeostasis is that of ecological succession in which the equilibrium is gradually changed by irreversible movements. This gets us right into the developmental process and into the theory of evolution, both biological and social. Mutation is a process by which new equations are introduced into the ecological system; selection is the process by which these equations result either in a new solution or in a rejection of the new populations. Likewise in the learning process, information put into the old structure of ideas, either coming from outside or generated from within, is a mutation which may be rejected or which may restructure the content of the mind into a new ecological pattern.

Teaching and Learning

We still have a long way to go before we can begin to understand the human learning process even though real progress is being made in this direction. We have even further to go before we can understand the process of education, which is by no means the same thing as learning. One of the things which is most puzzling is why some people survive the educational process and some do not—in the sense that after they have gone through formal education they never seem to learn anything again. The main object of formal education should be to teach people how to continue learning, yet as educators we fall very far short of this idea.

Recently I read a delightful statement that the year 1910 was a crucial year in human history because this was the year in which the medical profession began to do more good than harm. I wonder whether the teaching profession has reached this watershed yet. In the past I am sure we have often done more harm than good. I am almost certain the government has not reached the point of doing more good than harm. Every time Congress adjourns I draw a huge sigh of relief in that a damaging process has been temporarily suspended. Yet, as a teacher, I wonder if I am any better. The most depressing experience I ever had as a teacher was once while standing in the commencement procession at a little college where I was teaching, I overheard one senior say to another, both of them splendid in their caps and gowns, "Well, that is the last time I am ever going to have to crack a

book." I almost tore my hair in despair. How often, with our grades and quizzes and exams, assignments and curricula and all this do we destroy the learning process in our attempts at forced feeding?

Priorities In The Social Sciences

I would like to conclude by looking at some possible content areas of high priority in the social sciences which could contribute toward the larger ends which we have in view.

My first suggestion as to content is the comparative study of relatively stable cultures, most of which, of course, comes out of anthropology. A good deal of anthropology is at the level of natural history rather than analysis—interesting stories about strange people—but it does at least give the student the idea that there are many ways of doing things besides his own, and so opens up worlds of culture beyond his own back yard. It is important even for young children to have a feeling that there are a great many ways of doing things. I am convinced that if a thing is worth doing it is worth doing wrong, or at least worth doing in many ways. The curse of the British educational system in which I grew up was the idea that there is a right way to do everything. I have a vivid memory of a British mother at a swimming pool making her children absolutely miserable by saying all the time, "Swim properly, swim properly," while our children just swam cheerfully. The Russians are even worse than the British when it comes to the appalling concept of propriety, for there even ideas have to be "correct." Anthropology undermines propriety because it shows there are many different kinds of stable systems.

Even in complex social systems the student should be able to perceive certain stabilities and capacities for regeneration. Students can be made to perceive that the recovery of a society after a disaster, the regeneration of a limb of a star fish, and even the return of the liquor industry after prohibition are all examples of similar systems of regeneration and homeostasis.

Once we have established the idea that there are stabilities in equilibria we can then go on to dynamics, to developmental systems, and into concepts of economic and political development and ideological change. One of the unfortunate effects of Marxism and the cold war has been a polarization of views on the matter of dialectics. The communists cannot admit that there are any non-dialectical systems and we find it hard to admit that there are dialectical ones. This is disastrous, because obviously there are both and we need to see the total social dynamic process as a complex interaction of dialectical and non-dialectical elements. As a result of our polarization on this matter, both parties have developed unrealistic attitudes towards conflict. The dialecticians idealize it, whereas in this country we tend to suppress it because of our lack of confidence in our ability to manage it. We ought to be able to train people to feel that a well-managed conflict is a beautiful thing, and should not be suppressed. On the other hand, a badly-managed conflict can be disastrous for all parties. This is something which formal education does not seem to teach very well.

The institutions of formal education also seem to be insensitive to a very profound conflict which can neither be suppressed nor allowed to get out of hand between that part of the educational system representing the "super-culture"—the culture of science, airports, and universities which is pretty uniform all around the world—and the local, national, and folk cultures within which many institutions including elementary and secondary education still largely rest and by which they are supported.

An interesting example of this conflict at the moment is the tension which has been created between the universities and the Selective Service System over the issue of ranking. This is an issue which seems to have acquired a symbolic value far out of proportion to its intrinsic importance precisely because it is a symbol of the conflict between the super-culture of the university and the folk culture of Selective Service. This is a conflict which should not be resolved, although it does need to be managed.

Facts: How Many and What Kind?

One final question which puzzles me a good deal about formal education is what people should know in the way of plain old facts. General principles are obviously not enough. If you live in California you need to know that Sacramento is the capital, although you may not need to recall immediately what is the capital of Chad. We have never asked ourselves seriously what is the minimum that people need to know in the way of factual material. In the light of the knowledge explosion this question becomes more important all the time, for it becomes almost criminal to teach people things they do not really need to know, if this prevents them from learning things they do need to know. On this point I have four very tentative suggestions.

In the first place, we need to know something about the order of magnitude of the factual world. It is often more important to know orders of magnitude than it is to know about particular details. Thus, people ought to know in this country that agriculture is only 5% of the gross national product. We ought to know that the world war industry is equal to the total income of the poorest half of the human race. We ought to know that Japan in recent years has had a rate of economic development of 8 per cent per annum per capita, whereas the United States has had about 2½ per cent. We ought to have some idea as to what the "real maps" of the world look like. We often stuff students with names and dates and general principles, but there is an intermediate area of orders of magnitude that is neglected by everybody. Even in universities there is an incredible ignorance about the orders of magnitude of the world.

The second point is that it is often more important to know where to find information than to have it in your head. This is one point where my own formal training was sadly deficient. When I was at Oxford, for instance, the catalog of the Bodleian Library was written in elegant eighteenth century longhand in enormous and rather inaccessible volumes. This no doubt accounts for the fundamental Oxford principle that it is much easier to think something up than to look it up. In this day and age, however, we must teach people how to search for information. Computers and information retrieval are going to revolutionize the process of search. But in order to use information systems, one must have a certain amount of information to start with.

A third suggestion is that we need to give people factual information—at least on an order-of-magnitude basis—about the shape of the space-time continuum in which they live. This is history-geography, which to my mind should be the same subject, history being only geography in four dimensions. From the point of view of total earth, formal education does a poor job on this, mainly because it is deliberately distorted to create an artificial

national image. Thus students are surprised when they learn that medieval Europe was a peninsula on the edge of the civilized world, and that even at the time of the Roman Empire the Han Empire in China was probably superior in knowledge and technology. After about 700 A.D. there is little doubt that the most developed country was China, that Islam was the second layer of development, and Europe the third. In that period most advances in technology started in China and came to Europe by way of Islam. This is not the impression that we produce in our school system, and white Americans, at any rate, ought to know that their European ancestors were by no means top dogs, and that in the Middle Ages it would not be wholly unfair to categorize them as slowly emerging hillbillies.

The Limitations of Personal Experience

My fourth objective for formal education is to develop a lively appreciation of the nature and necessity of sampling and a distrust of purely personal experience. One of the fatal weaknesses of Deweyism is that while theoretically it emphasized starting from where the student is, in practice it often resulted in an emphasis on *being* where the student is. If where he is is in a backyard at West Lafayette, Indiana, where is that? The really interesting thing is not where you are but where you are not and the purpose of education is to get you from where you are to where you aren't. This is why a purely empirical bias in the culture can be very dangerous because it results in a bias of the attention toward what exists, whereas the things that do not exist are much more numerous and perhaps more important. Even in the evolutionary process many of the most interesting things were those which did not survive and we need to know why they did not.

One of the greatest political problems arises from the tendency of people to generalize from their own personal experience to propositions about society as a whole. Formal education should teach people that their personal experience, important as it is to them, is a very imperfect sample of the totality and we must give people an idea of *how* to sample this totality.

What formal education has to do is to produce people who are fit to be inhabitants of the planet. This has become an urgent necessity because for the first time in human history we have reached the boundaries of our planet and found that it is a small one at that—the space ship earth. This generation of young people have to be prepared to live in a very small and crowded space ship. Otherwise they are going to get a terrible shock when they grow up and discover that we have taught them how to live in a world that has passed away. The nightmare of the educator is what Veblen called "trained incapacity" and we have to be constantly on the watch that this does not become one of our main products.

1. Alfred Kuhn. *The Study of Society: A Unified Approach*. Homewood, Illinois: Richard D. Irwin, Inc., and The Dorsey Press, Inc., 1963.
2. Lawrence Senesh. *Our Working World: Cities at Work*. Chicago: Science Research Associates, Inc., 1967. p. 14. The last verse of Senesh's poem reads:

> If cities will be
> Rich, exciting, and bold,
> Using and treasuring
> New things and old,
> Safe, pleasant places
> For work and for play,
> The people who live there
> Must make them that way.